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ABSTRACT

A study investigated developments in reasoning and memory as reflected by the discovery strategies of children taking part in a manipulative categorization and recall task. A total of 40 children (8 each of 18, 24, 30, 36, and 42 months of age) participated. Stimulus materials consisting of blocks, toy plates, discs, and plastic trees were presented to subjects in two phases: a presentation and a test phase. The presentation phase involved play and discovery of items tagged with stickers depicting apples. The test phase involved a direct search for tagged items. Every move a child made to check an item for a sticker was transcribed and analyzed. Children from 18 to 42 months of age located tagged items in fewer moves in the test phase than they did in the presentation phase. Older children, in contrast to younger, conducted class-consistent searches, a phenomenon suggesting the possibility of rule use. Compared with younger children, older children in the presentation phase engaged in more class-consistent searching of both tagged and untagged items; however, in the test phase older children did not handle entire groups of untagged items. This latter finding suggests that a new strategy for learning about and encoding the environment begins to appear at around 3 1/2 years of age. (RH)

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Young Children's Reasoning and Recall in an Object Manipulation Task

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In the period from one to four years, children develop language very rapidly and extensively. This suggests that this is a dynamic period in the growth of the mind. Yet, very little work has been conducted that focuses on the development of mental functions besides language in children between one and four. Therefore, this paper seeks to examine developments in reasoning and memory in children between $1\frac{1}{2}$ and $3\frac{1}{2}$ years as reflected by the discovery strategies they employ in a manipulative categorization and recall task.

Previous research on reasoning and memory in children between $1\frac{1}{2}$ and $3\frac{1}{2}$ years is sparse. For example, memory for sets of objects has been studied only in children $2\frac{1}{2}$ years or older (e.g., Perlmutter & Ricks, 1979). Furthermore, in their everyday lives, very young children are rarely, if ever, asked to memorize events or objects as an end in itself. Consequently, it is not suprising that the instruction even to "remember" cannot be counted upon with children under three (Wellman, Ritter, & Flavell, 1975). Clearly, development of a sensitive nonlinguistic procedure is critical to assessing cognitive change in children who are just beginning to acquire language. With all of this in mind, then, we presented children with a nonlinguistic problem-solving task (in the form of a hiding game). We then re-presented the same task later, to see what the children remembered about what they had learned.

There were 40 children in this study--eight children each at 18, 24, 30,

36, and 42 months. We presented each child with a stimulus set composed of 16 small objects (Figure 1). The set consisted of four different classes of four identical objects each (4 square blocks, 4 toy plates, 4 discs, and 4 plastic trees). Eight identical stickers depicting apples were affixed to the underside of all four members of two of the four classes (e.g., apple stickers were affixed to the underside of the 4 square blocks and 4 toy plates). The object of the game was to find all of the stickers.

The same stimulus set was presented twice with an intervening delay of approximately twenty minutes during which the child was given other toys to play with. In the first presentation (referred to as the presentation phase), the set of objects was presented to the child in a loose, scrambled array with all of the stickers face down. The child was encouraged to play with the objects. When the first tagged object was turned over, either intentionally or accidentally by the child, the experimenter immediately drew the child's attention to the sticker. After discovery of the first tagged object, the experimenter showed the child how to peel the sticker off of the object. The child was then invited to peel the sticker off himself. Following this, the experimenter removed the object and prompted the child to return to the array and search for more stickers. As each tagged object was located by the child, the experimenter removed it from the array. The presentation phase was terminated when all of the tagged items were located and the child indicated that he would search no further. Following the delay, the same stimulus set was presented to the child again (referred to as the test phase) using the procedure outlined above. However, instead

of initially encouraging the child to simply play with the objects, the child was now asked to look for the "apples".

We transcribed and analyzed in order every move for which a child checked an object for a sticker. The first two measures I will report below were designed to establish overall base rates in children's checking behavior. The next three measures attempted to examine more closely the search strategies children use to solve the problem and how these strategies change with age and across phase.

Table 1 shows the total number of checked moves children made in order to complete the task. Averaging over both phases, the total number of checked moves did not vary significantly with age, $F(4,35)=0.30$, $p=.88$. On the average, children checked 11 objects before locating all of the tagged items. However, children checked significantly fewer objects in the test phase than in the presentation phase, reducing the number of moves from an average of 12 in presentation to 10 at test, $F(1,35)=7.41$, $p< .01$.

We next asked what percentage of these checked moves involved tagged, as opposed to untagged objects. Table 2 reveals that, once again, children of different ages did not differ significantly from each other in their tendency to locate tagged objects, $F(4,35)=0.13$, $p=.97$. Thus, averaging over the two phases, roughly 77% of the children's checked moves involved tagged objects. This figure suggests that children of all ages are locating the tagged objects with about equal ease. However, we see that here too, children are also becoming significantly more effective in locating the tagged objects in the test phase than the presentation phase, $F(1,35)=10.53$,

$p < .003$. Thus, on average, in the presentation phase, 73% of the children's checked moves turned up tagged objects; while by test, this figure significantly increased to 81%.

The above two measures reveal then that children's overall base rates in checking behavior do not vary with age; but these base rates do change significantly from presentation to test. In contrast to these cross-age similarities in the frequency of different kinds of manuevers, the organization of these moves changed with age and across phase. The next three measures are designed to show this change. For the first two of these measures, we asked if children ever checked all four members of a class in sequence. We examined this for both phases and for both tagged classes (Table 3) and untagged classes (Table 4). Then in the last measure, we looked at the probability that children at each age would select a tagged object on the first move in the presentation and in the test phase (Table 5).

Referring back to Table 3, we can see that either at presentation or at test, as age increases, the number of children serially checking all four members of a tagged class also increases. Thus, the older children tend to search for tagged objects in class consistent runs more frequently than the younger ones. Moreover, the marginals reveal that 27 out of 40, 68%--or more than half of all the subjects tended to search tagged objects in class consistent runs of four.

This general tendency to sequentially select tagged objects in class consistent runs contrasts sharply with the subjects' manipulation of untagged objects. In viewing Table 4, we can see that children between $1\frac{1}{2}$ and 3 rarely searched for all four untagged objects in class consistent

runs in either phase. At most, only 1 child at each of the four youngest ages searched untagged objects in a class consistent fashion in either phase. At 42 months, however, 3 of the 8 children in the presentation phase serially checked all four objects from an untagged class--and in immediate sequence. Importantly though, they did this only in the presentation phase--when first given the objects. They did not handle the untagged objects in class order when re-presented with the materials.

These oldest children differed from the younger groups in yet another way. Table 5 indicates that at the four younger ages, subjects selected a tagged item on the first move in the presentation phase at chance level. But they selected a tagged item first significantly above chance at test, $p < .03$. However, at 42 months, subjects' first selections did not differ from chance at either phase.

In summary, children at every age from 18 to 42 months found the tagged objects in fewer moves on the second presentation of these objects than on the first. This suggests that even at the youngest age, $1\frac{1}{2}$ years, children do have memory for where the stickers are located. The way children organized their search changed with age, however. The youngest children engaged in fewer class consistent searches of either tagged or untagged objects than did the oldest children. This suggests that these oldest children might be using a rule like: stickers are located on objects of a certain kind.

> For example, one 42-month-old in the test phase, checked a toy plate (sticker) and said: "They're on there." and pointed in the general direction of the plates. She said again: "They're

> on these." then selected a second plate. The E then queried: "They're on these?" and she responded: "On there." and pointed out all the plates. She then went on to locate the rest of the plates.

This example indicates that at least by 42 months, children may be solving the task with a rule of the form: certain kinds of objects may or may not have stickers, as opposed to certain objects having or not having stickers.

Additional support for this rule comes from the fact that the oldest, 42-month-old children engaged in more class consistent searching of both the tagged and untagged objects during the presentation phase. In the test phase, they initially spot-checked the untagged objects, but did not handle whole groups of them. Why would the oldest children check an entire class of untagged objects at presentation? We have suggested elsewhere that this development may be very noteworthy (Sugarman, 1982). It suggests that these oldest children may, in fact, be systematically organizing positive and negative instances in order to figure out, or at least verify, where the stickers are located. Thus, the 42-month-old who first finds a sticker on a plate, may then check the other plates to see if all the plates have stickers. Then the child might go on to check a tree to see if it does or if it doesn't have a sticker. If no sticker is present, then the child might check the other trees to see if these also do not have stickers. However, when the same objects are re-presented, the 42-month-old may decide from spot-checking that the origianl rules, about the things that do and do not have stickers, are still in effect.

This development of systematic attention to negative instances converges

withother findings we have on more open-ended problem-solving tasks. It suggests that a new strategy for learning about and encoding the environment begins to appear at around $3\frac{1}{2}$ years of age. This strategy could profoundly affect what gets learned, as well as how it gets learned.

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YOUNG CHILDREN'S REASONING AND RECALL
IN AN OBJECT MANIPULATION TASK

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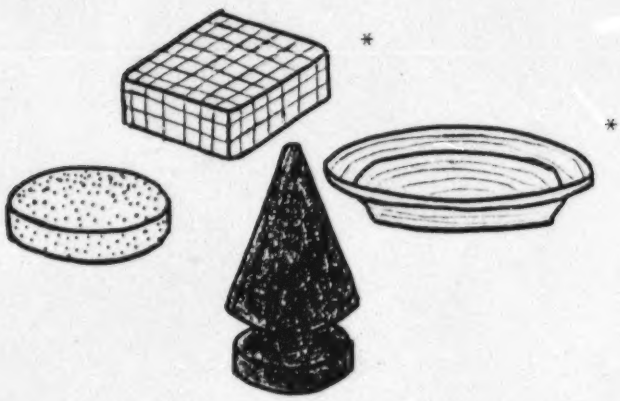
Figure 1. Task Stimuli



* Every member in designated class has a sticker attached underneath.

NOTE: Each class has four exemplars.

Table 1

Total Number of Checked Moves

PHASE [b]	AGE(months) [a] 18	24	30	36	42	Average
Presentation	11	11	12	11	13	12
Test	10	11	10	12	10	10

[a] ANOVA $F(4,35)=0.30$, $p=.88$: linear trend on age $F(1,35)=0.69$, $p=.41$

[b] ANOVA $F(1,35)=7.41$, $p < .01$

Table 2

Percentage of Checked Moves Involving Tagged Objects

PHASE [b]	AGE(months) [a] 18	24	30	36	42	Average
Presentation	76	74	71	76	67	73
Test	84	78	83	77	86	81

[a] ANOVA $F(4,35)=0.13$, $p=.97$; linear trend on age $F(1,35)=0.16$, $p=.69$

[b] ANOVA $F(1,35)=10.53$, $p < .003$

Table 3

Number of Ss with Class Consistent Runs of all 4 Tagged Objects in Presentation vs. Test Phase (cell n=8)

PHASE	AGE(months) 18	24	30	36	42	Marginal
Presentation	3	6	6	6	6	27
Test	4	4	4	7	8	27

Table 4

Number of Ss with Class Consistent Runs of all 4 Untagged Objects (cell n=8)

PHASE	AGE(months) 18	24	30	36	42	Marginal
Presentation [a]	0	0	0	1	3	4
Test	0	1	0	0	1	2

[a] $\chi^2(4)=7.29$, $p < .065$

Table 5

Number of Ss Selecting a Tagged Object on the First Move (cell n=8)

PHASE	AGE(months) 18	24	30	36	42	Marginal
Presentation	3	6	2	3	4	18
Test	7*	7*	7*	8**	5	34

*significantly different from chance, $p < .03$

**significantly different from chance, $p < .005$